Drivers behind the growth of seagrass and opportunistic macroalgae at Budle Bay, Northumberland.

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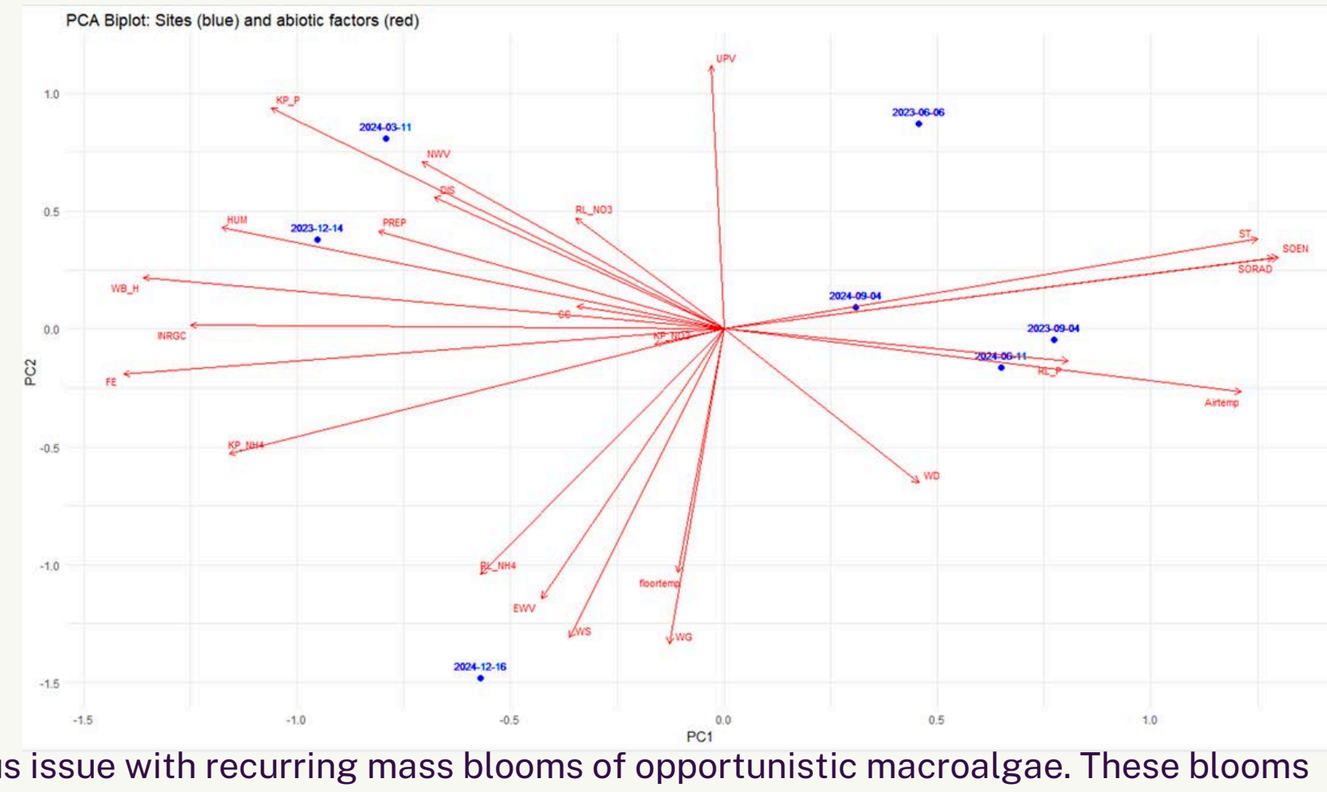


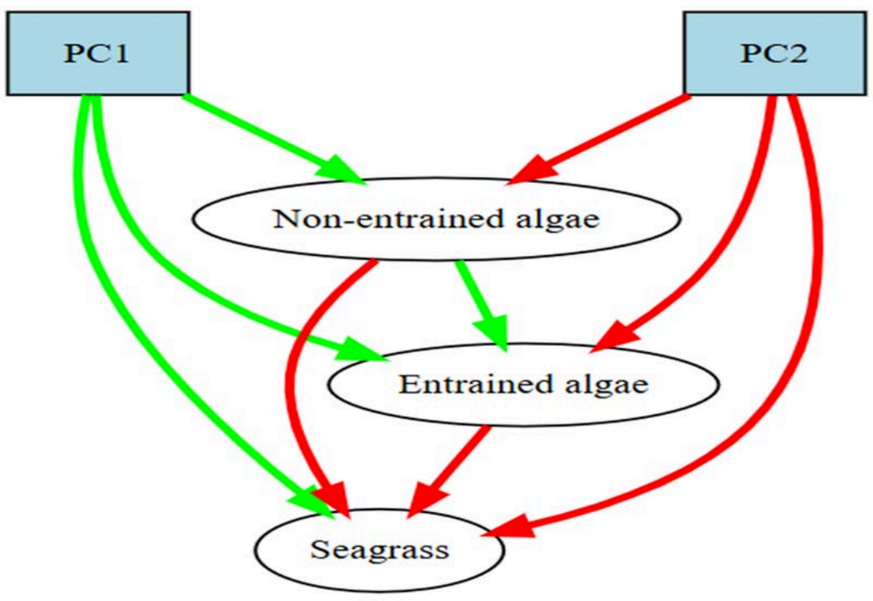
THE PROBLEM

Budle Bay, located in Northumberland, has been facing a serious issue with recurring mass blooms of opportunistic macroalgae. These blooms have increased in frequency and intensity year on year. Budle Bay is designated as a Special Protection Area (SPA) and a Site of Special Scientific Interest (SSSI) due to its population of overwintering birds primarily brent geese, and the presence of valuable seagrass habitats. The causes of these macroalgal blooms remain unclear, as do their potential impacts on the seagrass population. This study aimed to identify the primary environmental drivers behind the growth of these algae, assess whether the algae affect seagrass cover found at Budle Bay.

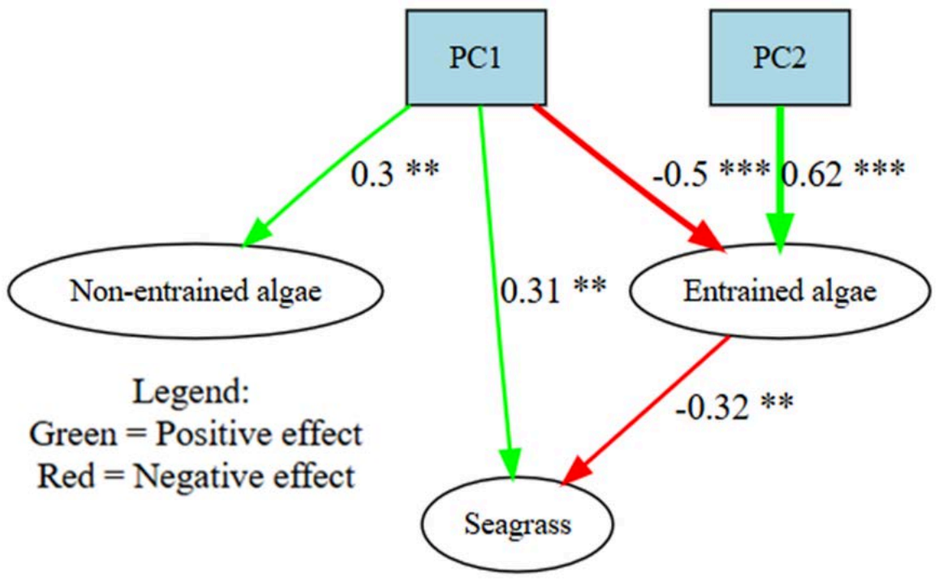
METHODOLOGY

Data on algae and seagrass cover at Budle Bay were recorded from June 2023 to December 2024. The algae were categorised into two groups: non-entrained algae, which were not bound to the sediment and could float in the water column, and entrained algae, which were bound to the muddy sediment and remained fixed in place regardless of water movement. Environmental data were gathered using visual crossing and copernicus for the same time. All environmental data were then standardised before a Principal Component Analysis (PCA) was performed to identify the key environmental gradients within the dataset. A conceptual model was created using ecological knowledge for comparison. The resulting PCAs were then incorporated into a Structural Equation Model (SEM) to assess the influence of these gradients on the dependent variables and to determine the direction of their effects. Non-significant effects were excluded to refine the final SEM model. RStudio was used for analysis.

Conceptual Model



Final Model



RESULTS

The PCA identified two major environmental gradients. PC1 represents a shift from summer-like conditions (higher air temperature, longer sunlight hours, and greater solar energy) to cooler, nutrient-rich conditions (higher humidity, iron concentration, and inorganic carbon). PC2 reflects a gradient from calm water movement to stormy conditions.

The conceptual model predicted that PC1 would increase the biomass of all groups; however, PC1 had a positive effect only on non-entrained algae and seagrass, while entrained algae biomass decreased. PC2 was expected to have the opposite effect, reducing biomass across all variables, but it significantly affected only entrained algae. This suggests that calmer conditions are associated with increased entrained algae biomass. Additionally, entrained algae exhibited a negative effect on seagrass cover.

While the PCA analysis captured clear and meaningful environmental gradients using a strong set of variables, it is not exhaustive. Although the relationships identified are statistically significant and ecologically relevant, they do not fully explain the complexity of the system. Additional environmental and biological variables may be required to draw deeper conclusions, particularly regarding the relationships among the different types of algae present.

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